exploratory trawling in lake ontario

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Division of Fish and Wildlife
1975

Ontario

Ministry of
Natural
Resources

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Minister

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Deputy Minister

Cover photo: Cod end of trawl, full of alewife, is hauled back on board the Leola Charles. All photos by Ted Jenkins

Contents

Acknowledgements

The information for this report has been obtained primarily from the following unpublished reports of the Ontario Department of Lands and Forests:

"Lake Ontario Exploratory Trawling, 1968", by Lloyd Thurston, Biologist.

and

"Lake Ontario Exploratory Trawling Program, 1969", by H. D. Howell.

Acknowledgements are due to the biologists Doug Howell and Lloyd Thurston, who directed the two phases of the trawling experiment, and to the Mummery brothers of Port Dover who undertook the actual fishing operations.

Introduction

Lake Ontario is primarily a deep cold body of water with the exception of the area in and around Prince Edward County, the Bay of Quinte and the North Channel. Historically, this lake has supported an active commercial fishery since the early 1800's. In the past 80 years, however, this fishery has witnessed a drastic decline in the traditionally important species of fish — the lake trout, *Salvelinus namaycush;* whitefish, *Coregonus clupeaformis;* ciscoes, *Coregonus* spp.; and yellow pickerel, *Stizostedion vitreum.* As a result, today's fishery in Lake Ontario is dependent on warm-water species such as yellow perch, *Perca flavescens;* white perch, *Roccus americanus;* carp, *Cyprinus carpio;* American eel, *Anguilla rostrata;* bullheads, *Ictalurus* spp.; and sunfish, *Lepomis* spp. It is only the shallow portion in the eastern end of Lake Ontario which supports the present fishery.

The offshore waters of the lake are populated mainly by two species of small fish — the smelt, *Osmerus mordax* and the alewife, *Alosa pseudoharengus.* Small quantities of smelt have been taken by the eastern Ontario fishermen in the spring but the remainder of these populations are unutilized. The abundance of alewives is frequently demonstrated in the spring when massive die-offs line the beaches of Lake Ontario with decaying fish.

In 1968, the Federal Department of Fisheries* and the Ontario Department of Lands and Forests** entered into a cost-shared agreement to undertake an exploratory fishing project on Lake Ontario. The purpose of this project was to determine

(a) whether commercially exploitable quantities of smelt and alewife could be located in Lake Ontario, and

(b) whether trawling was an economically feasible method for harvesting these populations.

The project was undertaken in two phases:

1) from July 24 to December 13, 1968
2) from August 1, 1969 to March 15, 1970.

The total cost for the experiment, $91,000, was shared equally by the Federal and Provincial Governments. In addition, the Department of Fisheries provided gear experts while the Department of Lands and Forests provided biological staff to work with the fishermen and analyze the catch.

* The Department of Fisheries, Canada is now part of Environment Canada.

** The Ontario Department of Lands & Forests was incorporated into the Ontario Ministry of Natural Resources on April 1, 1972.

Method

The Leola Charles, a Lake Erie trawler from Port Dover, was the vessel chartered to trawl for smelt and alewife in Lake Ontario.

The same Lake Erie trawler, the Leola Charles, was chartered by the Ontario Department of Lands and Forests to fish in Lake Ontario for both phases of the experiment. The Leola Charles, owned and operated by Don Mummery Fishery Limited of Port Dover, has the following dimensions:

length	— 63.5 feet
breadth	— 19.5 feet
depth	— 6.8 feet
gross tonnage	— 100.58 tons

The vessel was equipped with the following specialized equipment:

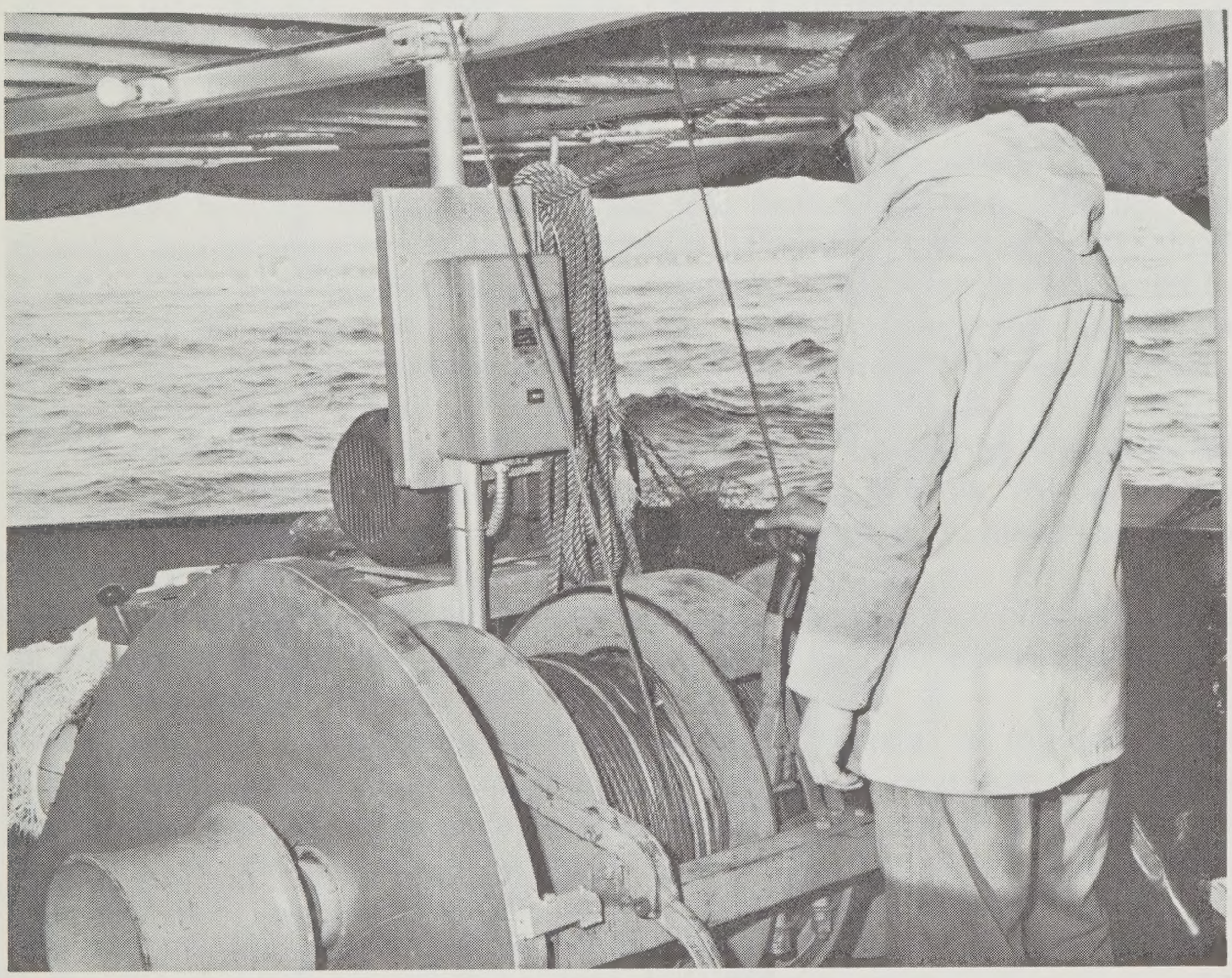
— Kelvin-Hughes MS-69 "white-line" echo sounder,

— electrically-powered Hathaway winch holding 100 fathoms of warp cables and 27 fathoms of sweep cables,

— metal-reinforced wood otter boards (3½′ x 7′),
— A-frame 16 feet above upper deck.

It was powered by a 300 horsepower Caterpillar diesel and had a 40,000 watt diesel-powered generator.

The crew of the vessel included the captain who was in charge of the operation of the vessel, a deck hand who operated the winch, and a gear technician who was familiar with the handling and repair of the trawls. Throughout the project, an employee of the Department of Lands and Forests was aboard the vessel to observe fishing operations and to maintain catch records.



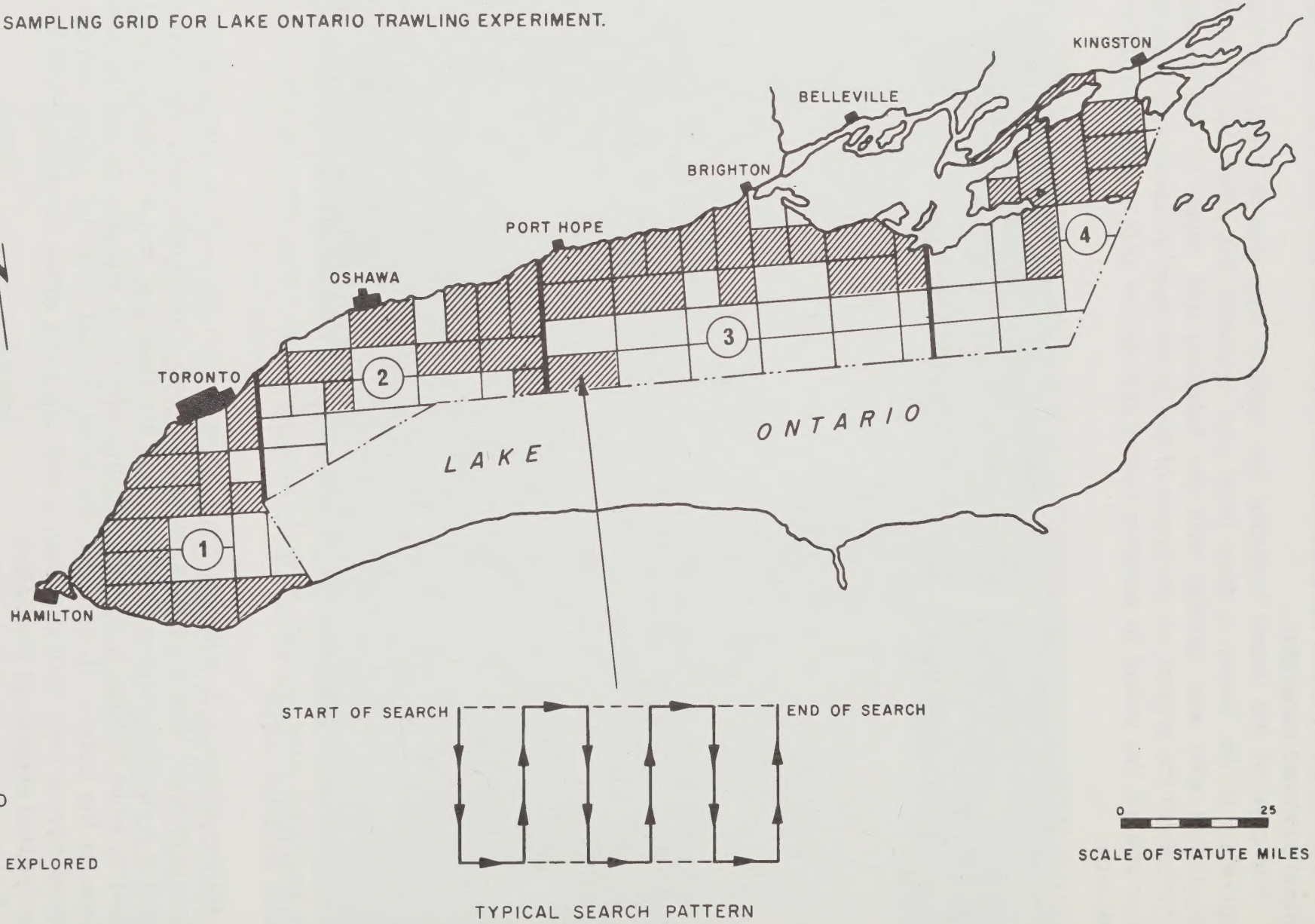
An electrically-powered winch holds the warp and sweep cables when the trawl is on board the Leola Charles.

During phase I, 5 different trawl types were used — 3″ modified Biloxi, large and small Western trawls, Wing trawl and a mid-water trawl. The Biloxi trawl is a modified shrimp trawl having a low head-line and a wide horizontal opening when fishing. It is most effective when fish populations are located close to the bottom. In contrast, the Western and Wing (or Vinge) bottom trawls have a high vertical opening and are used when fish concentrations are located slightly off the bottom.

The mid-water trawl is, as its name indicates, a trawl which fishes in mid-water. The depth of fishing is controlled by weights, floats, warp line lengths and door design. The cod end mesh size was 1¼″ for all of these trawls except the Biloxi for which it was 1⅜″.

In the second phase, the same gear was used except that a modified Texas trawl was substituted for the Wing trawl. The Texas trawl is also a modified

FIGURE 1. SAMPLING GRID FOR LAKE ONTARIO TRAWLING EXPERIMENT.



shrimp trawl and has the characteristic low head-line and wide horizontal opening. Variations in the mesh size of the cod end from 1⅛″ to 1¼″ to 1½″ were tested for efficiency on the Biloxi and modified Texas trawls only.

Phase I (July 24 - Dec. 13, 1968):

The primary objective of this phase of the experiment was to explore as much of the lake as possible by echo sounding. This would document the suitability of the bottom for a trawling operation as well as locating concentrations of fish.

To standardize exploration procedures, the Canadian waters of Lake Ontario were divided into four major areas which in turn were subdivided into sampling units of approximately 50 square miles. Figure 1 shows the 4 large areas and the sampling units covered during the time available. The inset to figure 1 illustrates a typical search pattern consisting of six parallel five-mile transects and five two-mile connecting transects.

When quantities of fish were indicated by the echo sounder in areas of favourable bottom conditions, the trawl was lowered to establish the fish quantity and composition. If the haul was substantial (1,000 lbs/30 min. tow) a second tow was made in the reverse direction. The vessel then returned to the search course at the point of departure. Light concentrations of fish on the echo sounder tape initiated a short tow of ten to twenty minutes to investigate species composition.

The secondary objective of this phase was to assess the feasibility of harvesting the observed stocks of fish on a commercial basis. This was done during a time when the local pet-food industries were able to make use of the fish, September 20 - October 22, 1968.

Fishing areas that had appeared favourable during the exploratory portion of the experiment were relocated and commercial harvesting was attempted.

Phase II (August 1, 1969 - March 15, 1970):

The purpose of this phase of the project was similar to the secondary objective of phase I — to duplicate a normal fishing operation in order to assess the feasibility of a commercial venture. The general area of operation was decided upon by the Department of Lands and Forests but the Captain made all decisions pertaining to trawl type, length of tow, specific trawling site and how the trawl was to be used.

The results of phase I were used to determine the three general areas in which the majority of fishing occurred (see Figures 2 & 3). These areas were the only ones where it was considered by the captain that sufficient quantities of fish could be taken.

Area A, a triangular-shaped area located in the extreme western end of the Lake, extends from the bell buoy off the Burlington Skyway Bridge northeast and east approximately eight miles. Tows were made at depths from 10 to 29 fathoms (18.8 to 53.0 metres). The best catches occurred in the most northerly part, near Bronte, late in the fall. It is in the southern part of this area that most (60.0%) of the net damage was encountered.

Area B was the most restricted area fished. It is an irregularly oval-shaped area, about five miles long and three miles wide lying immediately southwest of Toronto Island. Tows were made at depths from 6 to 29 fathoms (11.0 to 53.0 metres). The shallower, western part of the area was fished during the summer and fall and the deeper, eastern part was fished during the winter.

Area C, the only area fished in the eastern end of the lake, is the largest

area in which fishing occurred. It is an irregularly oval-shaped area, approximately eleven miles long and five miles wide extending easterly from within Prince Edward Bay. It is the area of the lake found to be most suitable for trawling during the 1968 program but was fished only slightly during 1969 due to the presence of a well established gill-net fishery. Tows were made in the area in water varying in depth from 15 to 20 fathoms (27.4 to 36.6 metres).

Two tows were made outside these areas, one in the Adolphus Reach north of Area C on September 10 and one off Port Credit on January 29. Only 60

FIGURE 2. AREAS WHERE TOWING OCCURRED IN WESTERN BASIN

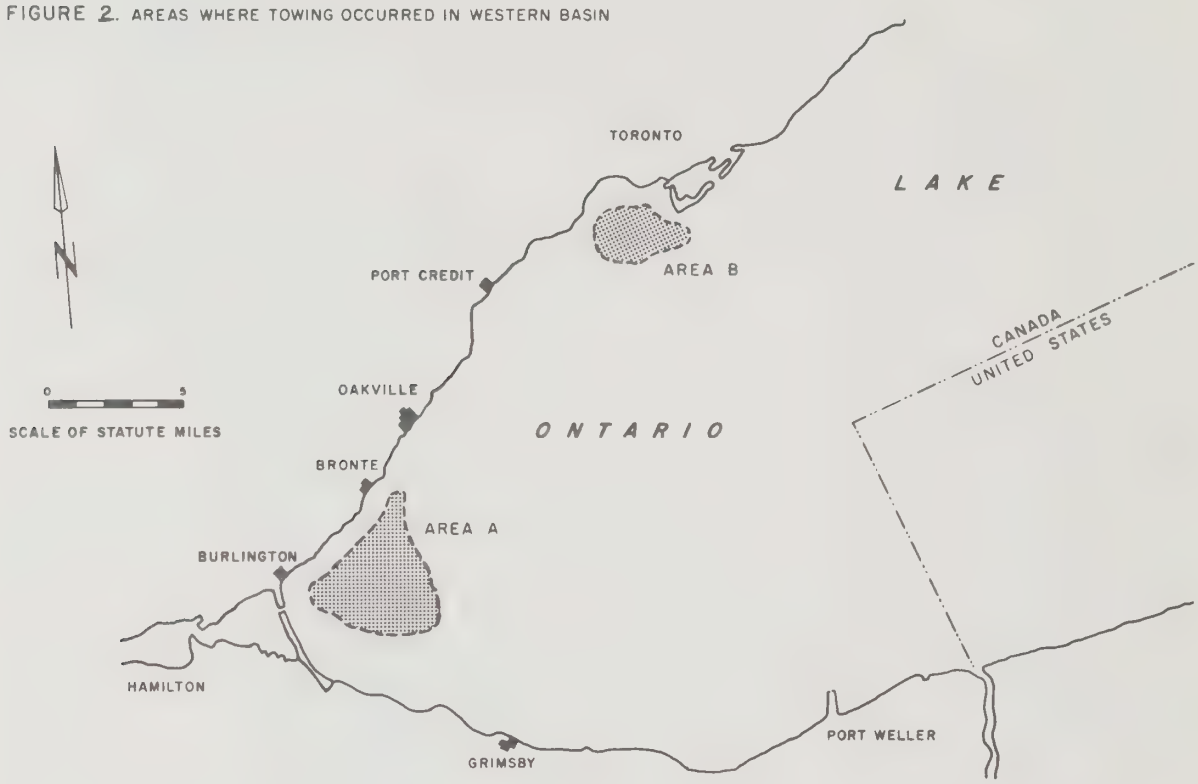
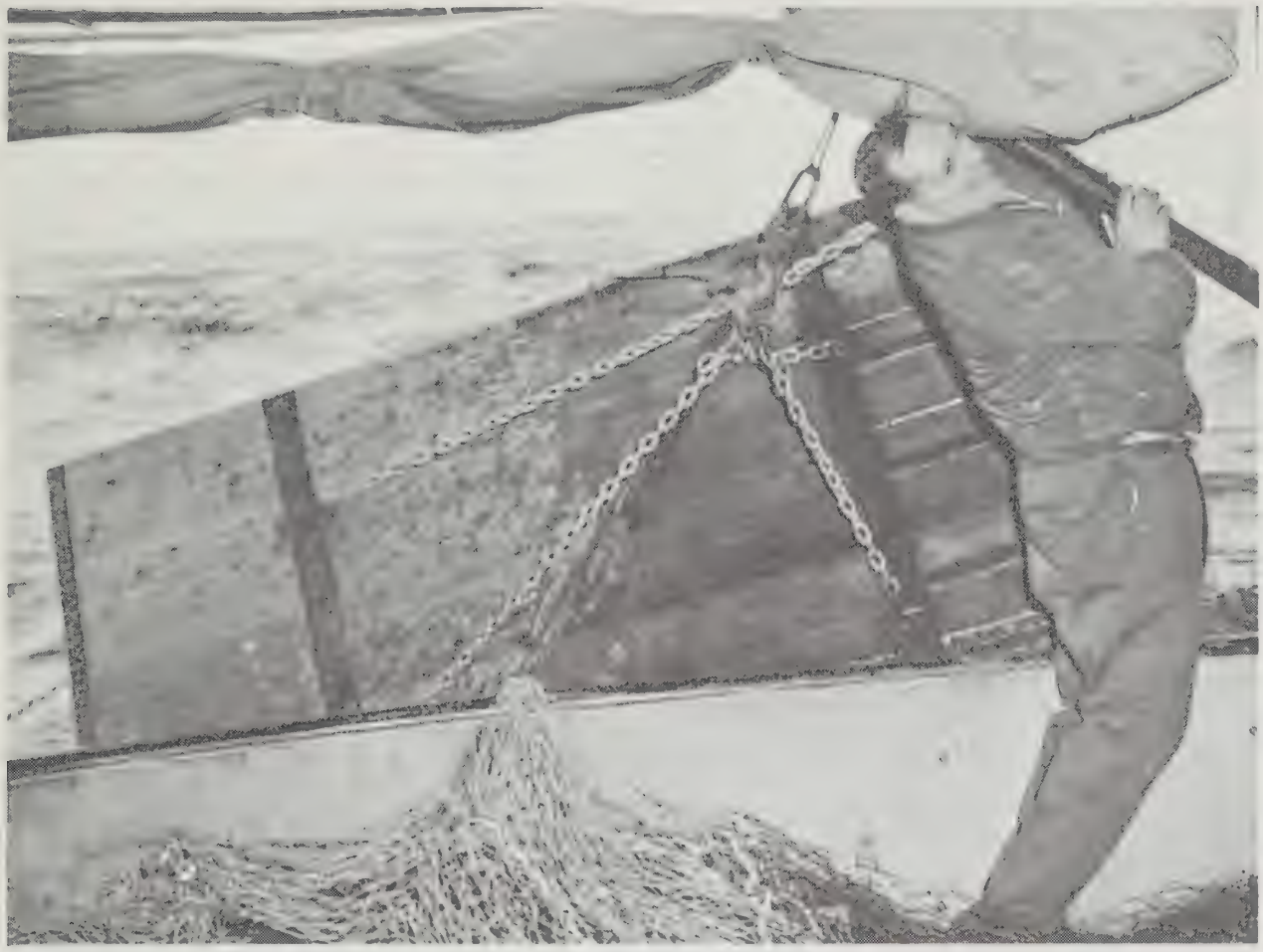


FIGURE 3. AREA WHERE TOWING OCCURRED IN EASTERN BASIN



Otter door being attached to the mouth of the net and lowered into the water. These doors, one on each side of the net, hold the net open while it is fishing in the water.

Paying out the net into Lake Ontario.

pounds of alewives were caught in the tow of September 10 and on January 29 the net being towed was damaged beyond repair with all the catch being lost.

No tows were made at depths greater than 29 fathoms because only rarely were fish schools found extending deeper than that, and the sweep cables used were only 27 fathoms (49.4 metres) in length. Fishermen avoid trawling in depths much greater than the length of the sweep lines since they would be unable to retrieve the otter boards if the net became caught on bottom.

The net slowly sinks as it is let out.

With the cod end full of fish, the net is pulled back to the boat after a tow.

Results

PHASE I:

A total of 47 actual trawling days was logged during this phase of the experiment. Since high wind and cold weather hindered trawling in November and December, the largest part of the 47 days occurred during August, September and October. The exploratory portion of this phase experienced considerable gear damage and corresponding down time for repairs. Total towing time (length of time the net was towed at trawling speed) was 61.6 hours making up 87 different tows.

Alewife was the major species in the catch (75 - 99%) totalling 57,241 pounds, followed by 19,882 pounds of smelt. No other species were caught in significant quantities (see table 1).

Table 1: TOTAL PHASE I CATCH BY SPECIES

	TOTAL CATCH in All Trawls in 3693 Minutes of Trawling Time	FISH SOLD to a Pet-Food Company(1) and Local Fish Buyers(2)
Alewife	57,241 lbs.	41,738 lbs.(1)
Small Smelt	18,079 lbs.	
Merchantable Smelt	1,803 lbs.	1,523 lbs.(2)
Troutperch	351 lbs.	
Yellow Perch	347 lbs.	43 lbs.(2)
White Perch	184 lbs.	
White Suckers	116 lbs.	
Spottail Shiners	1,630 no.	
Sculpins	433 no.	
Threespine Stickleback	114 no.	
Lake Whitefish	95 no.	91 lbs.(2)
American Eel	86 no.	144 lbs.(2)
Sea Lamprey	15 no.	
Cisco	13 no.	3 lbs.(2)
Pumpkinseeds	7 no.	
Rock Bass	8 no.	
Carp	3 no.	8 lbs.(2)
White Bass	14 no.	

NOTE: An additional 3,520 lbs. of alewife and smelt were given to two pet-food companies for experimental work and another 160 lbs. were delivered to the Fisheries Research Board for product development.

Echo soundings showed very few fish deeper than 30 fathoms and most fish concentrations were found directly on the bottom or within 3 fathoms of it. Of the waters explored between 0 and 30 fathoms, only 5% were suitable for bottom trawling. Two bodies of fish (alewife and small smelt) were found which could be considered for a commercial trawl fishery. These fish locations are shown in Figures 4 & 5. During August and September, these fish occupied shallow water (5 to 13 fathoms) moving to deeper water (15 to 29 fathoms) in October, November and December.

FIGURE 4. MAP OF WESTERN LAKE ONTARIO SHOWING CONCENTRATIONS OF FISH AT VARIOUS TIMES OF THE TRAWLING PROJECT IN 1968.

FIGURE 5. MAP OF EASTERN LAKE ONTARIO SHOWING CONCENTRATIONS OF FISH AT VARIOUS TIMES OF THE TRAWLING PROJECT IN 1968.

Mid-water trawling techniques could not be perfected during this experiment and as a result this trawl was not very effective. Of the other bottom trawls, the Wing trawl was found to be the most efficient (see table 2).

Table 2: EFFICIENCIES OF THE VARIOUS TYPES OF BOTTOM TRAWLS

Type of Trawl	Size of Cod End	Total Catch (lbs)	Minutes Trawling Time	C.U.E.*
3″ Biloxi	1⅜″	3,495	135	1554
Western Trawl (owned by Federal Government)	1¼″	7,958	241	1981
Western Trawl (owned by Don Mummery Ltd.)	1¼″	18,105	771	1410
Wing Trawl	1¼″	39,571	837	2837

*C.U.E. = Total pounds alewife and smelt caught per hour of trawling time during small commercial operations.

Operating costs for the Leola Charles were calculated to be $122.59 per day based on a 260 day working year (see table 3). In addition, the daily costs of transportation, freezing and possible storage would increase the actual operating cost to a maximum $243.36 per day if the fish could not be shipped directly to market (see table 3).

Table 3: OPERATING COSTS ESTIMATED FOR A COMMERCIAL TRAWL OPERATION (1968 values)

Item	Quantity		Cost
Vessel Operation:			
Fuel	9 gal./hr. for 9 hr. @ 25¢/gal.		$ 20.25
Wages	2 men @ $30.00/day		$ 60.00
100% depreciation on nets and repairs on nets/year	2 wing trawls/year at a cost of $900.00/trawl	*1800/260 =	$ 6.92
Depreciation on boat and equipment at the rate of 10%/year. Boat and equipment worth $70,000.00	10% of boat investment/year	*7000/260 =	$ 26.92
100% depreciation on wooden containers for fish	600 boxes/year @ 65¢/box	*390/260 =	$ 1.50
General repairs			$ 4.00
Food			$ 2.00
Ice			$ 1.00
TOTAL VESSEL OPERATION COST/DAY			$122.59
Fish transportation costs:	102 miles @ 32¢/mile		32.64
Freezing costs:	½¢/lb. x 11,749 lbs./day		58.75
Storage costs:	¼¢/lb./month x 11,749 lbs.		29.38
TOTAL OPERATION COST/DAY			$243.36

* Based on 260 work days/year.

Table 4: FISHING EFFORT BY AREA, TIME PERIOD, GEAR TYPE, PHASE II

Area	Time Period	Dates	No. of Days on which fishing occurred	Trawl Type	Cod end Size	No. of Tows	Towing Time min.	Towing Time hr.	C.U.E.*
A	1	Aug. 6-19	10	Western	1¼″	14	770	12.8	696
				Modified Texas	1½″	11	800	13.3	211
				Modified Texas	1⅛″	6	350	5.8	463
	2	Oct. 20-24	4	Western	1¼″	4	240	4.0	3123
	3	Dec. 8-22 & Jan. 29	8	Western	1¼″	9	545	9.1	1430
				Biloxi	1⅛″	3	150	2.5	6518
Total			22			47	2855	47.5	
B	1	Aug. 20-Sept. 5	11	Western	1¼″	25	830	13.8	1532
				Modified Texas	1⅛″	5	148	2.5	1718
	2	Sept. 26-Oct. 16	13	Biloxi	1⅛″	13	405	6.8	2086
				Western	1¼″	9	237	3.9	2262
				Small Western	1¼″	6	205	3.4	861
	3	Dec. 29-Mar. 13	34	Biloxi	1¼″	28	1175	19.6	4874
				Biloxi	1⅛″	12	645	10.8	3538
				Modified Texas	1¼″	8	300	5.0	9152
				Western	1¼″	2	75	1.3	3068
				Small Western	1¼″	1	25	0.4	—
Total			58			109	4045	67.5	
C	1	Sept. 10-23	10	Biloxi	1½″	14	730	12.2	1047
				Mid-water	1¼″	5	315	5.2	69
Total			10			19	1045	17.4	
GRAND TOTAL			90[1]			175	7945	132.4	

[1] Value is one greater than actual no. of days fished due to fishing in two areas on Jan. 29.

* C.U.E. — Catch in lb. of smelt and alewives per hr. of towing time.

PHASE II:

Catch and Effort:

Although the vessel was present in Lake Ontario for a period of nearly six months, fishing occurred on only 89 days. During these 89 days, 175 tows were made for 132.4 hours (7,945 minutes) of actual towing time. The breakdown of this effort by area, date, time and gear type is given in table 4.

The total catch (table 5) was dominated by smelt and alewife. Since the catch of other species was less than 0.2 percent of the total it was not considered in calculations of average catches, percentages, or catches per unit of effort.

Table 5: SPECIES COMPOSITION OF CATCH, PHASE II

Species	Wgt. or No.*
American smelt *(Osmerus mordax)*	237,018
Alewife *(Alosa pseudoharengus)*	66,940
Troutperch *(Percopsis omiscomaycus)*	582
Sculpin *(Cottus* spp.)	408
Yellow perch *(Perca flavescens)*	140
Lake whitefish *(Coregonus clupeaformis)*	87
White perch *(Roccus americanus)*	81
American eel *(Anguilla rostrata)*	67
Gizzard shad *(Dorosoma cepedianum)*	66
White bass *(Roccus chrysops)*	36
Sea lamprey *(Petromyzon marinus)*	18
Emerald shiner *(Notropis atherinoides)*	16
Cisco *(Coregonus* spp.)	7
White sucker *(Catostomus commersoni)*	4
Threespine stickleback *(Gasterosteus aculeatus)*	4
Spottail shiner *(Notropis hudsonius)*	2
Rock bass *(Ambloplites rupestris)*	2
Freshwater drum *(Aplodinotus grunniens)*	1
Logperch *(Percina caprodes)*	1
Northern pike *(Esox lucius)*	1

*Note: Smelt and alewife catches in pounds — all others in numbers

The total weight of smelt and alewife taken throughout the program was 303,958 pounds with smelt constituting 78.0 percent. Due to the differences in price for different sizes of smelt, the catches of smelt were graded by size into three lots: small (less than 6″ in length); medium (6″ to 7.5″); and jumbo (larger than 7.5″). The size of smelt taken ranged from lengths of less than 2 inches for some young-of-the-year fish to over 12 inches. The largest smelt recorded was 13.1 inches (total length), a female taken in mid-December. The alewives taken ranged in size from 2.4 inches to 8.6 inches with the majority being in the 5 to 8 inch range. No sorting by size was needed as alewife were sold in bulk as animal food.

The breakdown of the catch by area, time period and size class is shown in Figure 6. The only area in which significant catches of commercially valuable fish other than smelt and alewife were taken was area C. Here the catch included 140 yellow perch, 85 whitefish, 75 white perch and 67 American eels.

Handling of Catch:

Throughout the program all catches were handled with the specific intention of selling them. Early in the program catches were low and were comprised mainly of alewives and small smelt. After sorting by hand, they were packed in waxed or plastic-lined cardboard boxes. The small smelt and alewives were frozen and stored for subsequent sale as mink and pet food respectively. The larger smelt were sold for human consumption to retailers in Hamilton, Toronto and Port Dover. Consistently good catches were not made so it was not possible to penetrate new markets by guaranteeing a constant source of high quality fresh fish.

Later in the program (from December through March) the catches were much larger, with a high percentage of larger smelt and a low percentage of alewife. A mechanical sorter was used to sort out the smaller smelt. Alewives were still separated by hand. The small smelt and alewives were packed separately in heavy plastic bags for freezing while the larger smelt were handled in wooden boxes and sold to wholesalers who normally handle Lake Erie smelt. This was possible because ice conditions on Lake Erie prevented fishing for smelt throughout most of the winter. In addition, some fish were still sold directly to retailers.

The prices received for each species and size class remained fairly constant throughout the period, averaging $.035 per pound. The amount sold, value and average selling price are given in table 6.

Table 6: WEIGHT AND VALUE OF FISH FROM SALES RECORDS

Species — Size	Amt. sold lb.	Value $	Ave. price $/lb.
Alewife	58,592	1468.37	.025
Smelt — small	120,490	2801.40	.023
Smelt — medium	105,600	5098.20	.048
Smelt — jumbo	5,344	650.16	.122
Yellow Perch	8	.80	.100
Whitefish	146	73.00	.500
American Eel	150	37.50	.250
TOTAL	290,310	$10,129.43	

Operating Costs:

Since operating costs vary greatly from vessel to vessel, the crew was required to supply a report on the costs of operation of the particular vessel involved. Their report (appendix) indicated that a minimum of $115.00 per day would have to be realized from the catch to meet operating expenses. This is based upon five fishing days per week. In the winter, when weather conditions could restrict the number of fishing days per week, the average cost would be high since the major cost, labour, is fixed.

During the 89 days of actual trawling in phase II of this experiment, 290,310 pounds of fish were caught and sold for a value of $10,129.43. The average daily catch would therefore be worth $113.81.

As indicated by the fishermen, this operation could meet the operating costs but not the additional costs of transportation and storage of the catch.

Discussion

PHASE I:

Trawl damage was extensive during the exploratory portion of this phase while winds hampered the production portion. Due to these problems, the economic feasibility of a commercial operation could not be directly determined. However, the following information was obtained:

(a) an average of 4.14 hours of a 9-hour work day was spent actually trawling. The rest of the day was spent shooting and lifting the net and traveling to and from the fishing grounds (see table 7).

(b) the Wing Trawl averaged 47.3 x 60 = 2,838 pounds of smelt and alewife per hour of actual trawling time.

(c) at 2¢/lb., an average day's catch of 4.14 x 2,838 = 11,749 pounds would be valued at $234.98.

(d) operating costs associated with a commercial venture = $243.36 per day.

From these figures it appears that daily operating costs exceed the catch value by $8.38. Such a marginal difference however, does not conclusively eliminate this trawling as a possible commercial venture.

Table 7: EXPECTED ACTUAL TRAWLING TIME PER 9-HOUR WORKING DAY (4 TRAWLS PER DAY)

Operation	Time Expended for operation (hours)	No. of Times operation conducted	Total Time Expended for Each operation (hours)
Running from Port to Location of Fish	1.25	1	1.25
Dropping Trawl	0.17	4	0.68
Lifting Trawl	0.17	4	0.68
Emptying Trawl	0.25	4	1.00
Return to Port	1.25	1	1.25

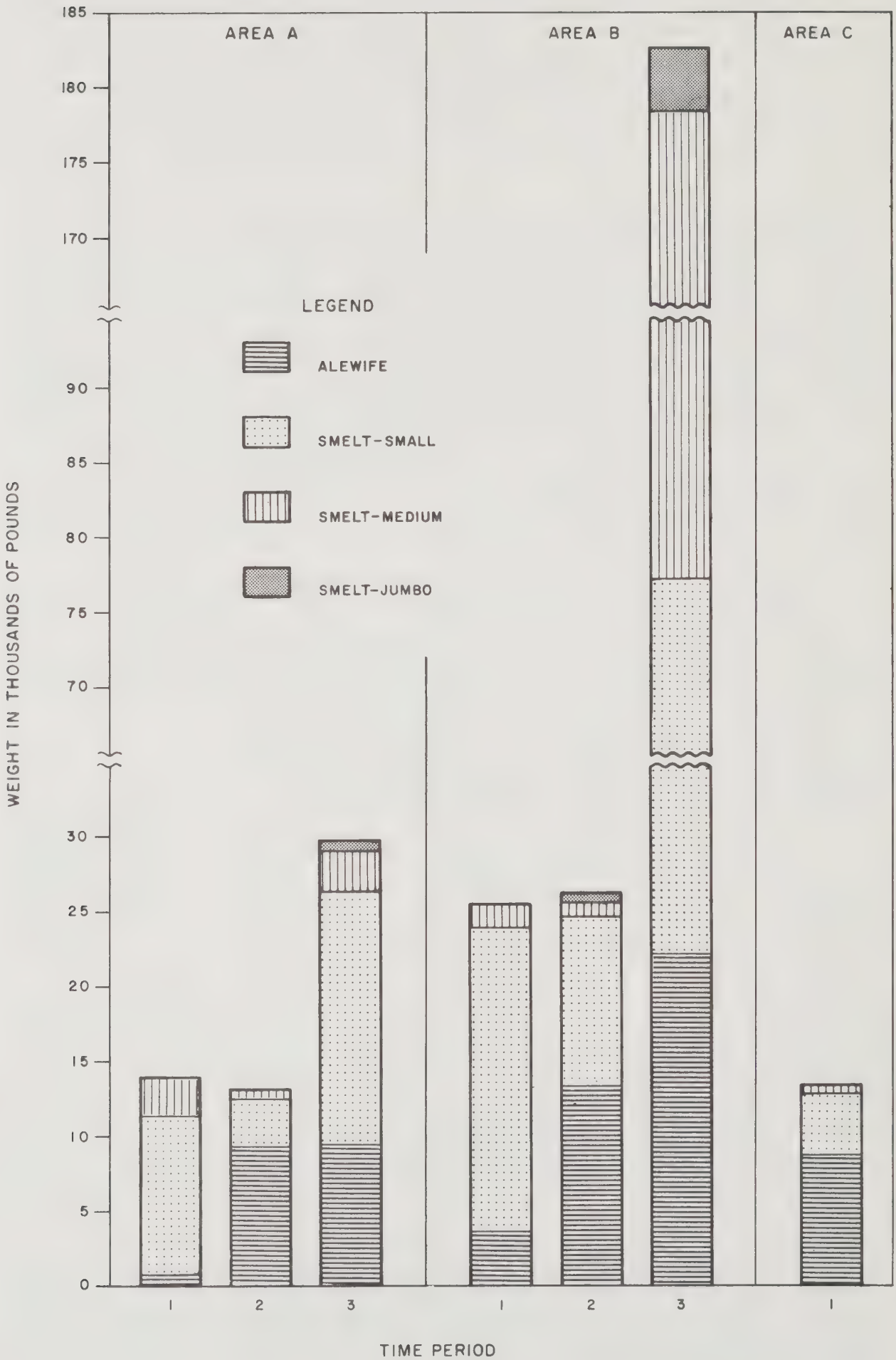
Total Time involved for Non-Trawling Operation = 4.86 hours

Expected Actual Trawling Time per 9-Hour Working Day is then (9.00 − 4.86) 4.14 hours

PHASE II:

Examination of the available data for catch per unit effort (C.U.E.) indicates that the Biloxi-style net gave consistently good to excellent catches except when it was fished in area C. The western-style net produced only poor to fair catches during its use. The catches taken with the modified Texas net

FIGURE 6. TOTAL CATCH BY AREA, TIME PERIOD, AND SPECIES



showed the greatest variation. Early in the program its catches were among the lowest encountered while in the last week of the program its performance was 40.4% greater than that for any other net as indicated by the C.U.E. This might be the result of the higher vertical opening of the Texas trawl which would be able to fish the densest portion of the fish concentrations, located slightly off the bottom. The small western-style trawl and the mid-water trawl were not used extensively, but produced low catches.

Fishing effort and catch varied greatly from area to area.

(1) Area A: 35% of the effort produced only 18.5% of the catch with an overall C.U.E. of 1,184 pounds/hr. Since most of this effort (67.4%) was expended early in the program when fish catches were low for all areas and types of gear, this C.U.E. is considered to be low for area A. Later in the program a C.U.E. of 6,518 pounds per hour was experienced with the Biloxi-style net. It was also found that the southern half of the area, where most of the fishing occurred, had lower concentrations of fish and produced frequent gear damage. Some of the largest catches were taken in the northern part of the area off Bronte.

(2) Area B: 50.9% of the effort produced 77.2% of the catch with the highest C.U.E. recorded (3,480 lbs/hr). This area was the smallest of the three but its proximity to adequate harbour and freezing facilities made it the most popular during the winter months when high concentrations of fish were located. The frequency of alewife in the catch was also low during this period (12.1%) allowing the mechanical sorter to be used and larger catches to be processed.

(3) Area C: 13.3% of the effort produced only 4.3% of the catch. This area was the most productive in phase I of the project but it was only explored during one time period early in phase II. Due to the inadequate coverage of this area it is possible that concentrations of fish went undetected and the catch may not be indicative of the true potential of area C.

Two species, namely smelt and alewife, constituted over 99.8 percent of the catch. Although 18 other species were taken, their contribution to the total catch was negligible.

Smelt, the major species taken (78.0% of total catch), was present in the catch of 170 of the 175 tows. Four of the five ineffective tows did not produce any fish due to gear damage and the other tow, in which only alewives were taken, was made using the mid-water net. The catch rate for overall effort was 1,790 pounds per hour while the rate for effective effort was 1,808 pounds per hour.

No large catches of smelt were taken during the first three months of the program, although on occasion, particularly late in October, some good catches were made. In the winter months however, the catches increased greatly (figure 6) and some tows produced over 7,000 pounds of smelt. The greatest amount of smelt taken in one tow was on March 9, when a 45-minute haul produced 12,870 pounds.

Not only did the size of the smelt catches increase from the summer through the winter period, but the average price per pound increased as well. The reason for this is that during the early part of the program medium and jumbo smelt (value $.048 and $.122 per pound respectively) constituted only 10.6 percent of the smelt catch while during the winter months they constituted 60.3 percent. This increase in percentage of larger smelt is attributable

possibly to growth but more likely to the adult fish becoming concentrated in the fishing area prior to spawning in the spring.

The availability of smelt to bottom trawls in areas of Lake Ontario obviously varies greatly throughout the year. In areas A and B concentrations of fish were found in water less than 15 fathoms in depth during the first part of the program. When runs were made out into deeper water, the echographs showed that the fish usually remained concentrated in a band extending from 8 to 15 fathoms. Where this depth interval contacted the bottom, the concentrations of fish were heaviest. During the winter months, the main concentrations were found in areas between 22 and 30 fathoms. Again, even in deeper areas, few fish showed at depths greater than this.

Although alewife constituted only 22% of the catch in phase II, two exceptionally large catches of alewife were taken, one off Bronte and one off Toronto.

Alewife, which constituted only 22.0 percent of the catch, was present in 155 of the 175 tows. The catch rate for overall effort was 506 pounds per hour and for effective effort was 559 pounds per hour. As with smelt, no larger catches of alewives were taken until the winter months, although some good catches were made in late September and October. Two exceptionally large catches (6,315 pounds taken off Bronte and 7,920 pounds taken off Toronto) were made during the winter. These two catches constituted 21.3 percent of the total catch of alewife. The rest of the catches made during the winter were, with few exceptions, small (less than 500 pounds).

The variations in catches were greater for alewives than for smelt. Good catches were never made consistently because alewives did not appear to remain concentrated in the fishing areas (particularly area B) for very long.

The reasons for this are not known, but it is suspected that weather disturbances causing changes in current patterns are involved. Even when alewife concentrations were high, the additional time required to sort a catch prevented much fishing on those days resulting in a reduced catch.

The efficiency of the operation was limited by three major factors — poor weather, restricted trawling areas and inadequate handling techniques. Not only did poor weather prevent the boat from venturing forth but the direction of winds and currents could prevent any effective tows from being made on the limited areas. In addition, storms could shift the location of fish concentrations off the suitable trawling areas so that catches were poor or fishing had to be suspended.

The distance between suitable trawling locations was so great that moving to an alternate area was not practical because of the running time involved.

To satisfy the demands of the various markets, the catch, which rarely consisted of only one species, had to be sorted. This placed a direct limitation on the amount of fish which could be taken. When sorted for size and species by hand, about 1,000 pounds could be handled per hour. Later a mechanical size separator improved the rate to 2,000 pounds per hour but species separation still had to be done by hand.

Subsequent to sorting, fish for immediate sale were placed in small wooden boxes holding about thirty-five pounds each. Fish to be frozen and stored were packed in cardboard boxes or heavy plastic bags holding from 30 to 50 pounds. A bulk handling technique would save much of the time and labour expended using these methods.

ECONOMIC FEASIBILITY:

The costs of operating a trawler were estimated by Lloyd Thurston in phase I of this experiment and by the Mummery Brothers in phase II. As a comparison to these estimates, the average daily cost of a trawler on Lake Erie was obtained from the data collected in 1973 by Larry Lambert for his Master's thesis entitled "An Economic Study of Ontario's Lake Erie Commercial Fishery" (State University of New York). In this study it was found that the average Lake Erie tug was 22 years old and had a sale value equivalent to its purchase price. Thus there does not appear to be an appreciable depreciation factor. However, to keep these vessels in sale condition, basic maintenance costs are incurred and these costs have been equated to a depreciation factor.

Table 8: DAILY OPERATING COSTS (Assuming 260 Active Days)

	1968 L. Ont.	69/70 L. Ont.	1972 L. Erie*
Wages	$60.00 (2@$30)	$80.00 (4@$20)	$68.24 (4 07@$22.80)
Fuel	20.25	12.00	6.38
Net	6.92	—	18.84
Depreciation/ Maintenance	26.92	—	13.36 Mtce. & Fin.
Insurance	—	12.00	0.18
Licence	—	—	0.92
Miscellaneous	8.50	6.00	3.12
TOTAL	$122.59	$110.00	$111.04

* Corrected to 1968 dollar value

Table 8 illustrates the similarity between the operating costs from phase I, phase II and the 1972 Lake Erie information corrected for the change in dollar value between 1968 and 1972.

The question of economic feasibility does not seem to be definitely answered. To meet basic trawler operating cost, the catch must have a minimum daily value of about $115. Transportation costs and any storage costs would increase this basic value by varying amounts depending upon the location of markets and the shipping arrangements made with the processor. These costs calculated for phase I, equalled $120.77 as outlined in table 3.

Since the fish do not have to be iced in the winter, the Mummery Brothers felt that trawling in Lake Ontario could be feasible during the winter months. In addition, some consideration was given to the fact that the boat would not be utilized in Lake Erie at that time of year because of the ice conditions. However, the fixed portion of the trawler operating costs which would result whether trawling or not, are small in comparison to the variable costs such as wages, fuel and repairs which are incurred during actual operation.

It appears from the data available that this operation would be marginal at best unless the daily catch could be increased or the price paid for the fish improved.

Conclusions

Phase I of this project established two areas in Lake Ontario, one in the eastern basin and one in the western basin, where concentrations of fish coincided with suitable bottom topography for trawling (see figures 4 and 5). Initial attempts at production fishing provided very limited data on its economic feasibility. The possibility of marginal profits indicated that additional investigations were warranted.

During phase II of the project, most of the trawling took place in the western basin with minimal effort expended in the eastern portion of the lake. In addition to the trawling area which was discovered in the western basin during phase I, another concentration of fish was located just off Toronto harbour. The species, size composition and density of the three concentrations of fish varied throughout the year. Consistently large catches of smelt and alewife could only be made during the winter months in the western basin. Markets were available for both smelt and alewife with prices ranging from 2.5 to 12 cents per pound. From an economic viewpoint, it appears that a commercial trawling operation for smelt and alewife in the western basin of Lake Ontario could be marginally profitable during the winter months of the year in conjunction with another fishing operation during the rest of the year.

Catches of one species only were rarely made indicating that smelt and alewives are not very often segregated in Lake Ontario. The time required to sort the catch is thus a major limiting factor which would have to be reduced before the stocks could be readily utilized. The development of a mechanical sorter or markets which would accept a mixed catch, would be possible solutions to this problem.

Addendum

Since the completion of this project in the spring of 1970, experimental trawling permits have been made available to fishermen equipped to operate a smelt and alewife trawl fishery in western Lake Ontario. The Mummery brothers took out permits in the winters of 1970-71 and 1971-72. No trawling was done during the first winter since the Welland Canal closed before the Leola Charles could leave Lake Erie. During the winter of 1971-72, the Leola Charles harvested 71,825 pounds of smelt and 1,510 pounds of alewife. Poor weather conditions and the long commuting distance from Port Dover to the Toronto Harbour were major factors limiting the success of this venture.

Until the fall of 1974, no other interest in this fishery has been shown. The long and lucrative open-water season on Lake Erie during the intervening winters has diverted most of the operators with adequate boats and gear from capitalizing on the limited opportunities in Lake Ontario.

Appendix

COMMENTS OF FISHERMEN

In our mind, the only feasible time that you could make commercial fishing a profitable operation is from December until late March, especially since the fish do not have to be iced as in the summer. The alewife and small smelt could be left on the boat until the next day, if you were not finished sorting before the freezer closed for the day.

The sale of the large smelt depends on the weather conditions in Lake Erie. If the smelt grow ¾ to 1 inch in length during the next year, the Lake Ontario smelt should be as large as Lake Erie smelt. The return on them should be high as you would be more competitive in the smelt market, especially around Toronto.

We also think that, in the Prince Edward Bay area, the potential is very good because it is close to the Quaker Oats Cat Food Factory.

Through conversation with Mr. Bob Prentice, it was learned that they (Quaker Oats) would take fresh fish on the days they are running fish. This means you could save some freezing and handling costs. With the mixture of other commercial fish, we certainly think that this is one area of the lake where trawling could be a profitable proposition. The only drawback is the unloading facilities, as they are not the best.

Listed below is what it cost per day to operate profitably based on a four-man crew and away from home.

Wages: $20/day x 4 men	=	$80.00
Oil appr.	=	12.00
Food appr.	=	6.00
Truck expense	=	5.00
Insurance on boat	=	12.00
TOTAL		$115.00

So if every day you could get on the lake and realize $150 to $200. worth of fish you could make it pay. As for the cost of freezing, handling and storage of junk fish (small smelt and alewife) it varies with the amount of fish you catch but last year the average cost per pound was between ½ and ⅝ of a cent per pound.